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AXILLARY STRUCTURE OF THE TORTRICIDAE (LEPIDOPTERA)

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Abstract.—A fourth axillary sclerite (axillary$_{1A}$) is reported within the hindwing base of the Tortricidae. Pivot points of coupled forewings and hindwings in tortricids are in the same plane, parallel to the median longitudinal body axis. These observations contradict previous interpretations that imply pivotal points must be contiguous to their corresponding body segment. Supportive evidence regarding our findings is provided by photographs of whole mount preparations and a diagrammatic illustration.

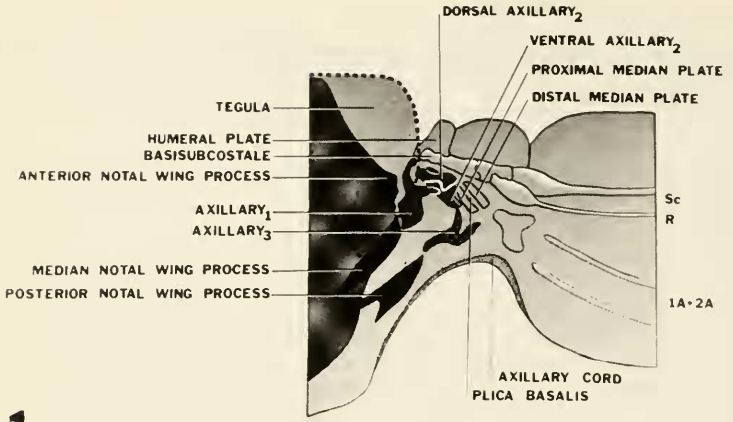
The axillary area of Lepidoptera has been studied by several early investigators (Comstock and Needham, 1898–99; Berlese, 1909; Crampton, 1909, 1920; Snodgrass, 1909, 1935). Recent work by Sharplin (1963a, 1963b, 1964) on lepidopteran wing articulation has provided nomenclatural stability, has more clearly defined functional organization, and has traced an evolutionary series from monotrysian to ditrysian forms.

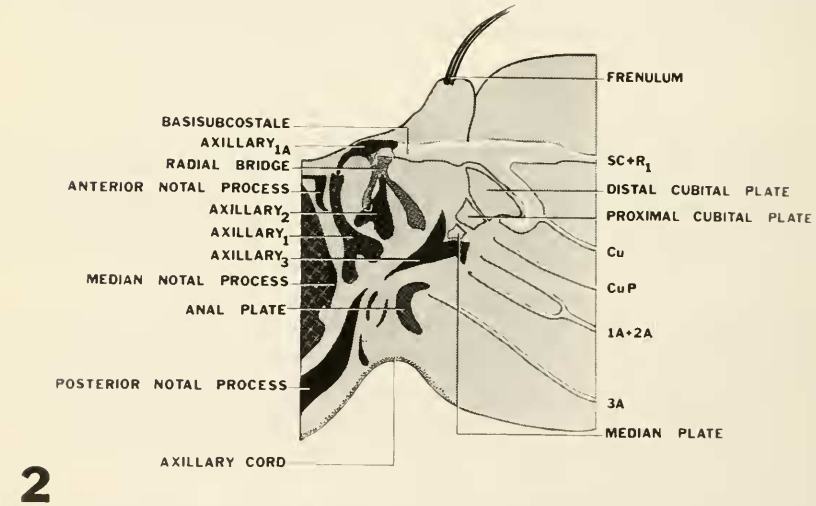
Wing folding of Lepidoptera, with respect to the axillary sclerites, has been reviewed by the aforementioned investigators, however, emphasis was restricted to the forewing. This paper describes a new axillary sclerite in the base of the hindwing of Tortricidae and discusses the morphological relationships between the anterior hinge of the forewing and hindwing as to their function in wing folding.

The present morphological work was conducted as a part of a taxonomic revision of Nearctic species of the moth genus *Apotomis* Hübner (Olethreutinae). All tortricid species examined exhibit pivot points of the hindwing in the same plane as the forewing, parallel to the median longitudinal body axis. These findings contradict previous interpretations that imply pivotal points are contiguous to their corresponding body segment. A study of this discrepancy has led to our discovery of a fourth axillary sclerite within the hindwing base of Tortricidae.

Materials and Methods

Eight species of Tortricidae were examined; these represented two of the three subfamilies of North American Tortricidae, as recognized by Powell





Figs. 1, 2. Wing bases of *Apotomis albeolana*. 1, Forewing. 2, Hindwing.

(*in press*). Species of Tortricidae examined are: Tortricinae: *Acleris minuta* (Robinson), *Choristoneura fumiferana* (Clemens), *Archips cerasivoranus* (Fitch), *Tortrix viridana* (L.); Olethreutinae: *Apotomis albeolana* (Zeller), *Hedia ochroleucana* (Hübner), *Cydia pomonella* (L.), *Grapholita molesta* (Busck). Specimens of the Chlidanotinae were not available for study.

Specimens were heated in 10% KOH until cleared. Pterothoracic segments were dissected along the median longitudinal body axis and treated

Table 1. Structural differences between forewing and hindwing bases of Tortricidae.

Structure	Forewing	Hindwing
Median arm of axillary$_1$	present (well developed)	absent
Cubital plates	absent	present
Median plates	present (well developed)	present (reduced)
Radial bridge	absent	present
Axillary$_2$	complex	simple
Axillary$_{1A}$	absent	present

with Mallory's triple stain (Barbosa, 1974). Right half-sections were slide mounted in balsam. Left half-sections were studied in temporary glycerine mounts using depression slides. Phase contrast and interference contrast microscopes were used to examine both sections of the pterothorax. "True" pivot points were determined from glycerine by securing the thorax with forceps and flexing the forewing and hindwing.

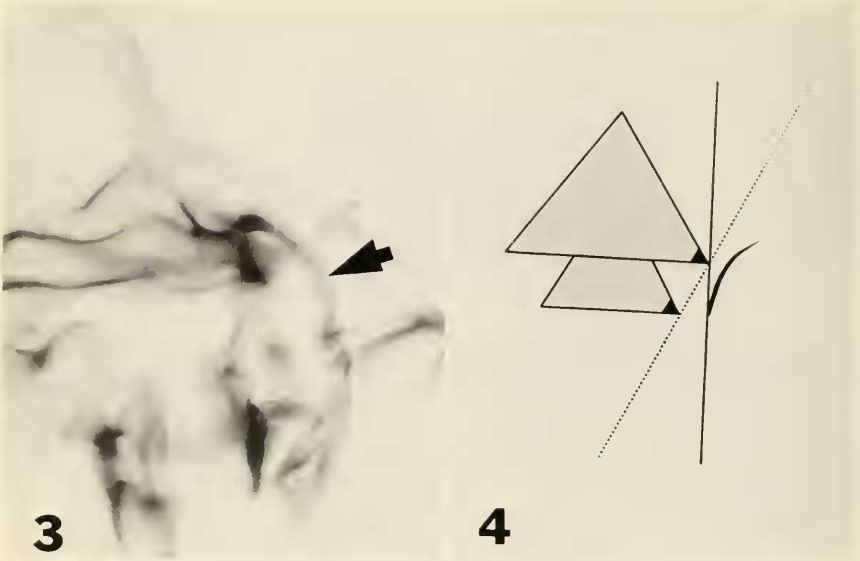
Results and Discussion

Forewing and hindwing bases of examined specimens are similar to descriptions by earlier workers. Differences between forewing and hindwing bases are illustrated (Figs. 1, 2) and are summarized (Table 1). Except for axillary$_{1A}$ (which Sharplin, 1963b, misidentified as the basisubcostale in the hindwing of *Tortrix viridana*) our findings agree with Sharplin (1963a, 1963b).

The small axillary$_{1A}$ (Fig. 3) is received by a cuplike invagination of the anterior apex of axillary$_1$. Movement of axillary$_{1A}$ is restricted by a flat strip of thin cuticle attached to its base. Axillary$_{1A}$ articulates distally with the basisubcostale. This juncture marks the "true" pivot point of the hindwing.

Figure 4 is a diagrammatic representation of the tortricid pterothorax with the large triangle representing the mesothorax, followed by the smaller metathorax. According to the workers previously cited, the blackened apexes would depict the approximate location of axillary$_1$. In their interpretation the pivot point axis represented by a broken line is contiguous to the respective body segment. However, our study reveals the observed pivot point axis to be along the solid line, axillary$_{1A}$ of the hindwing, accounting for the difference in angle.

We have not conducted an extensive survey throughout the order to determine if the axillary sclerite we describe is present only in the tortricids; the literature does not indicate its presence in other lepidopteran families. The structure may have originated along the axis (solid axis of Fig. 4) where the wing buckled due to frenular wing coupling and the mechanical stress



Figs. 3, 4. 3, Hindwing base of *Apotomis albeolana*; axillary$_{1A}$ indicated by arrow (100×). 4, Diagrammatic representation of the tortricid pterothroax. Large triangle represents mesothorax, small triangle represents metathorax. Blackened apexes depict approximate location of axillary$_1$ demarking the pivot point axis represented by a broken line. Observed pivot point axis is along the solid line. Note that the frenulum is along observed pivot point axis.

at that point. We suggest that this hypothesis could be tested outside the tortricidae. Further studies are needed to (1) define structural and functional homologies of axillary$_{1A}$ and (2) determine to what degree, if any, wing coupling (jugal lobe, frenulum, or expanded costa of the hindwing) is correlated with the evolution of axillary$_{1A}$.

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